Intrinsic/Extrinsic

Density-Ellipticity Correlations and Galaxy-Galaxy lensing

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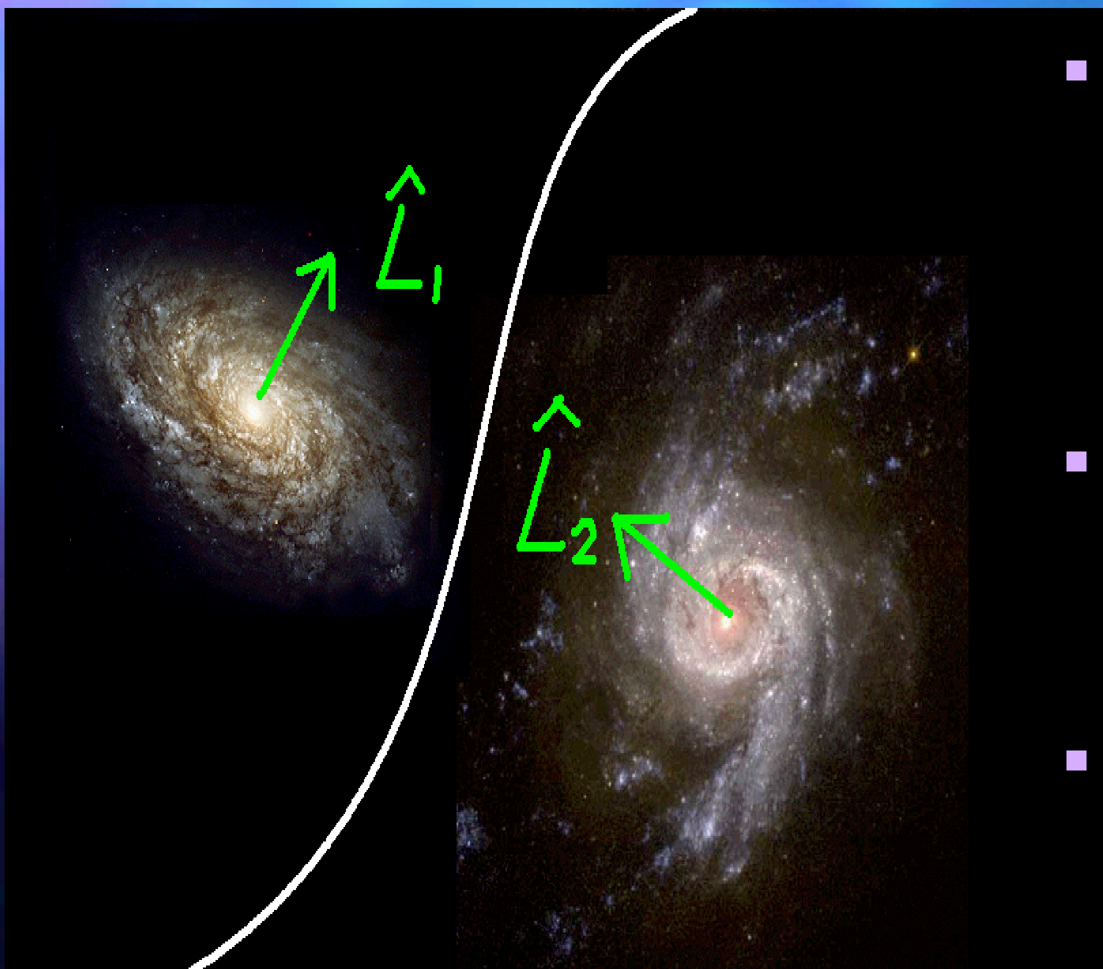
Weak Lensing

- **Weak Gravitational lensing provides a direct probe of the large scale distribution of mass.**
- **Analyses by several groups have demonstrated that measurements of galaxy shapes can be made sufficiently precise to detect such an effect. The most commonly investigated statistical quantity is the correlation between Galaxy ellipticities.**
- **As the precision improves, it is important to understand possible small contaminations to the lensing signal.**

Intrinsic Alignment



- Since the ellipticity of a galaxy is related to the direction of its angular momentum, contaminations from intrinsic alignment might be expected due to long range tidal correlations.
- One possible way to exclude intrinsic from extrinsic (lensing) correlations is to choose a different statistical strategy.
- What we have done is to calculate density-ellipticity correlations.

Is it a contamination?

- In standard perturbation theory, the intrinsic correlations can be given by the following equation:

$$\left\langle \delta(\vec{\theta}_1)\gamma_i^{in}(\vec{\theta}_2)\right\rangle = \sum_{A,B} C_{AB}^{i}\left\langle \nabla^2\phi(\vec{\theta}_1)\phi_A(\vec{\theta}_2)\phi_B(\vec{\theta}_2)\right\rangle$$

  Where ' δ ' is the density fluctuation , ' γ ' is the ellipticity of a galaxy, ' ϕ ' is the gravitational potential, A and B signify various second derivatives.

- If we assume that the gravitational potential has a Gaussian fluctuation, the intrinsic correlations vanish immediately due to the parity of the equation.

- In real observation, we should also include the source clustering correction. With some mathematics, we can show that this correction also vanishes under the assumption of Gaussian distribution (Lam Hui & Jun Zhang, astro-ph/0205512).

What's really going on behind?

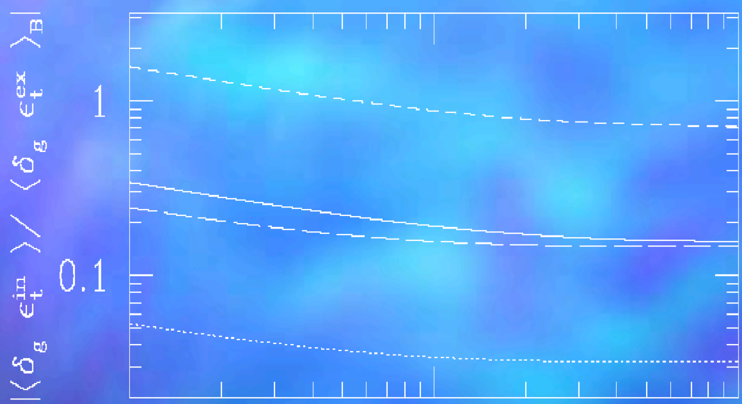


Fig 1. Ratio of intrinsic signal to extrinsic signal for two different selection functions. The short-dashed and solid lines correspond to a shallow survey with the short-dashed line using Z_T=3, and the solid line using Z_T=50. The long-dashed and dotted lines correspond to a deep survey, with the long-dashed line using Z_T=3, and the dotted line using Z_T=50. Z_T is used to fix the growth of the angular momentum of galaxies.

- **Concerning the nonlinear effect in perturbation theory, the Gaussian distribution can not be the real case.**
- **The intrinsic alignment induces a non-negligible contribution to the observed density-ellipticity correlation, especially for a shallow survey. For a sufficiently deep survey, however,intrinsic alignment contributes only at the level of a few percent.**
- **We have assumed a linear galaxy-bias in the calculation. On small scales, this relationship will be more complicated. But on large scales, it is quite likely that this relation is true (see e.g. Scoccimarro et al. 2001).**

Conclusions

- We compute both extrinsic (lensing) and intrinsic contributions to the density-ellipticity correlation function. The later is done using current analytic theories of tidal alignment.
- We found that under the assumption of the Gaussianity of the tidal field, the intrinsic contributions vanishes as well as the corrections from the source clustering effect.
- Non-Gaussian fluctuations from gravitational instability induces a non-zero intrinsic density-ellipticity correlation, which is not negligible, especially at small scales.